INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LGS-G SERIES

MP MASTER
MA28637

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

PRELIMINARY

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LGS-G SERIES

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LGS-G models unless otherwise specified.

LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.

MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

WS-8-6393

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SPECIFICATIONS AND FEATURES

DC OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I
VOLTAGE AND CURRENT RANGES

MODELS	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°C	50°C	60°C	71°C
LGS-G-5-OV-R	5 ± 5%	200	180	155	130
LGS-G-6-OV-R	6 ± 5%	170	151	132	109
LGS-G-12-OV-R	12 ± 5%	105	95	85	70
LGS-G-15-OV-R	15 ± 5%	85	75	65	55
LGS-G-20-OV-R	20 ± 5%	62	55	48	40
LGS-G-24-OV-R	24 ± 5%	54	48	42	35
LGS-G-28-OV-R	28 ± 5%	46	42	36	30

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range. Derate output current rating 10% for 187-242 VAC ("V" option) input.

REGULATED VOLTAGE OUTPUT

Regulation ..... 0.1% line or load with input variations from 105-132 or 132-105 volts AC and load variations from no load to full load.

Ripple and Noise ..... 10mV RMS, 35mV peak-to-peak for LGS-G-5-OV-R, -6-OV-R models; 15mV RMS, 100mV peak-to-peak for LGS-G-12-OV-R, -15-OV-R, -20-OV-R, -24-OV-R, and -28-OV-R with either positive or negative terminal grounded.

Temperature Coefficient ..... Change in output voltage 0.03%/°C max.

Remote Programming

External Resistor ..... Nominal 1000 ohms/volts output.

Programming Voltage ..... One-to-one voltage change.

Remote Sensing ..... Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

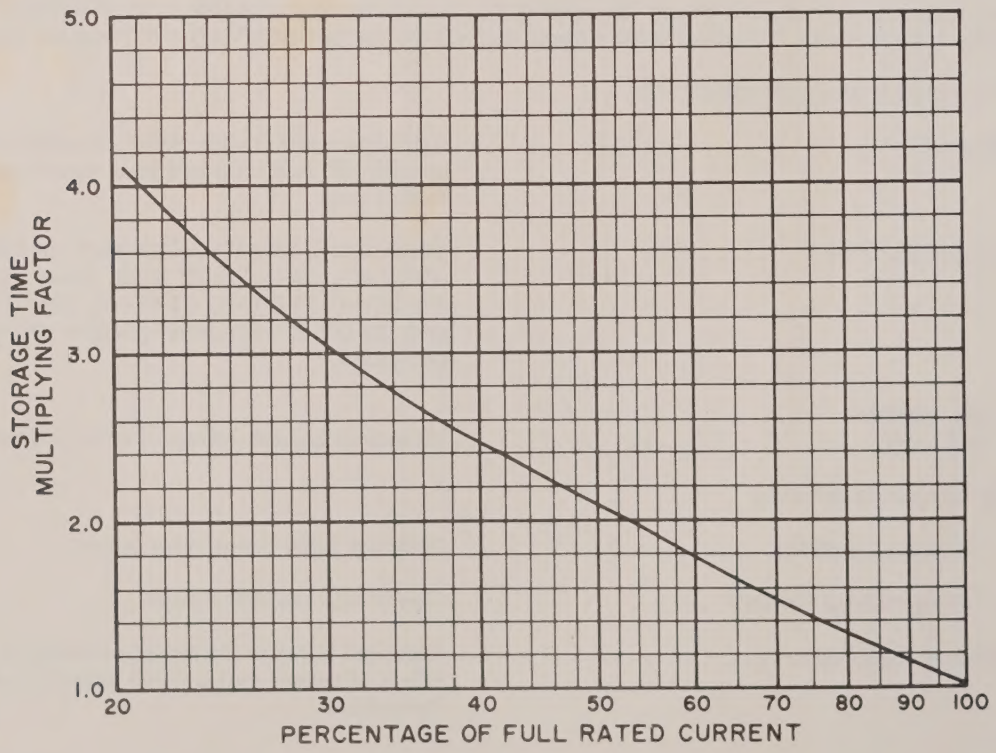
STORAGE TIME — Determine storage time regulation after input power failure as follows:

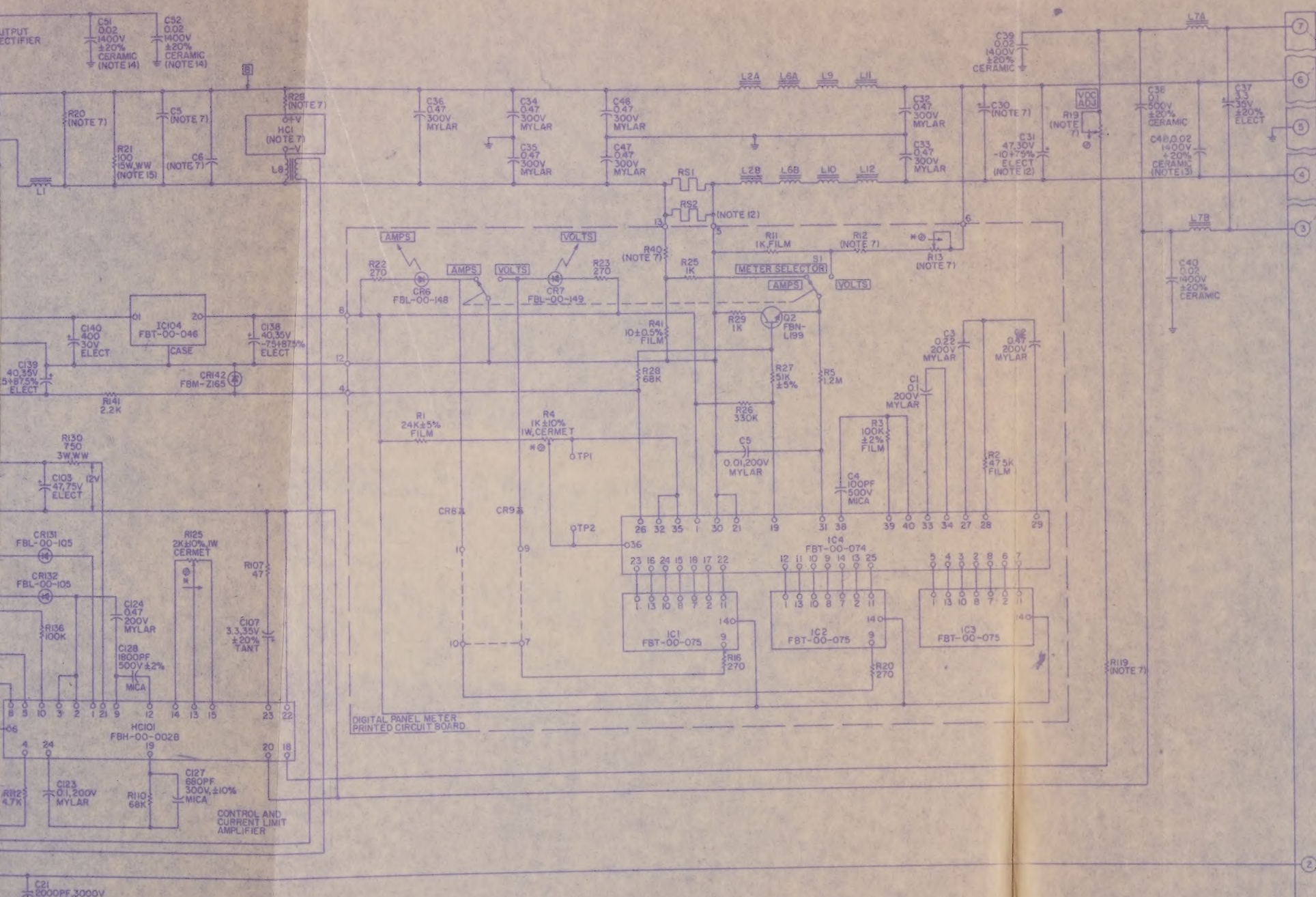
1. Find storage time at full rated current from chart below.
2. Determine percentage of full rated current for desired application.
3. Find multiplying factor on graph below.
4. Apply storage time formula:

$$S = (F)\,(M)$$

where S = storage time
F = storage time at full rated current (see chart)
M = multiplying factor (see graph)

MODEL	STORAGE TIME (ms) AT FULL RATED CURRENT
LGS-G-5-OV-R	16.5
LGS-G-6-OV-R	16.5
LGS-G-12-OV-R	1.0
LGS-G-15-OV-R	2.0
LGS-G-20-OV-R	6.0
LGS-G-24-OV-R	5.0
LGS-G-28-OV-R	5.0





NOT USED ON MODELS LGS-G-5-0V-R THRU LGS-G-12-0V-R.

CR133,CR134,RS2 ONLY USED ON MODELS LGS-G-5-0V-R THRU LGS-G-6-0V-R. CR110,CR111,CR112,Q113,Q114,R115,R116 USED ON MODELS LGS-G-5-0V-R AND LGS-G-6-0V-R.

NOT USED ON MODELS LGS-G-20-0V-R THRU LGS-G-28-0V-R.

NO C52 ONLY USED ON MODELS LGS-G-12-0V-R AND LGS-G-15-0V-R.

ONLY USED ON MODEL LGS-G-20-0V-R AND LGS-G-24-0V-R.

UNITS WITH "V" OPTION: DOTTED CONNECTION SHOWN C17, CR8 REPLACES CONNECTION TO C1, C2 ; C23 IS .400V MYLAR , F1 IS 20A , T1 HAS TAPPED PRIMARY. OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING PUR AND WHT TRANSFORMER LEADS) OR FOR 215-265V INPUT (USING BRN AND YEL TRANSFORMER LEADS). F2 AND S1B ARE ONLY USED ON UNITS WITH "V" OPTION.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

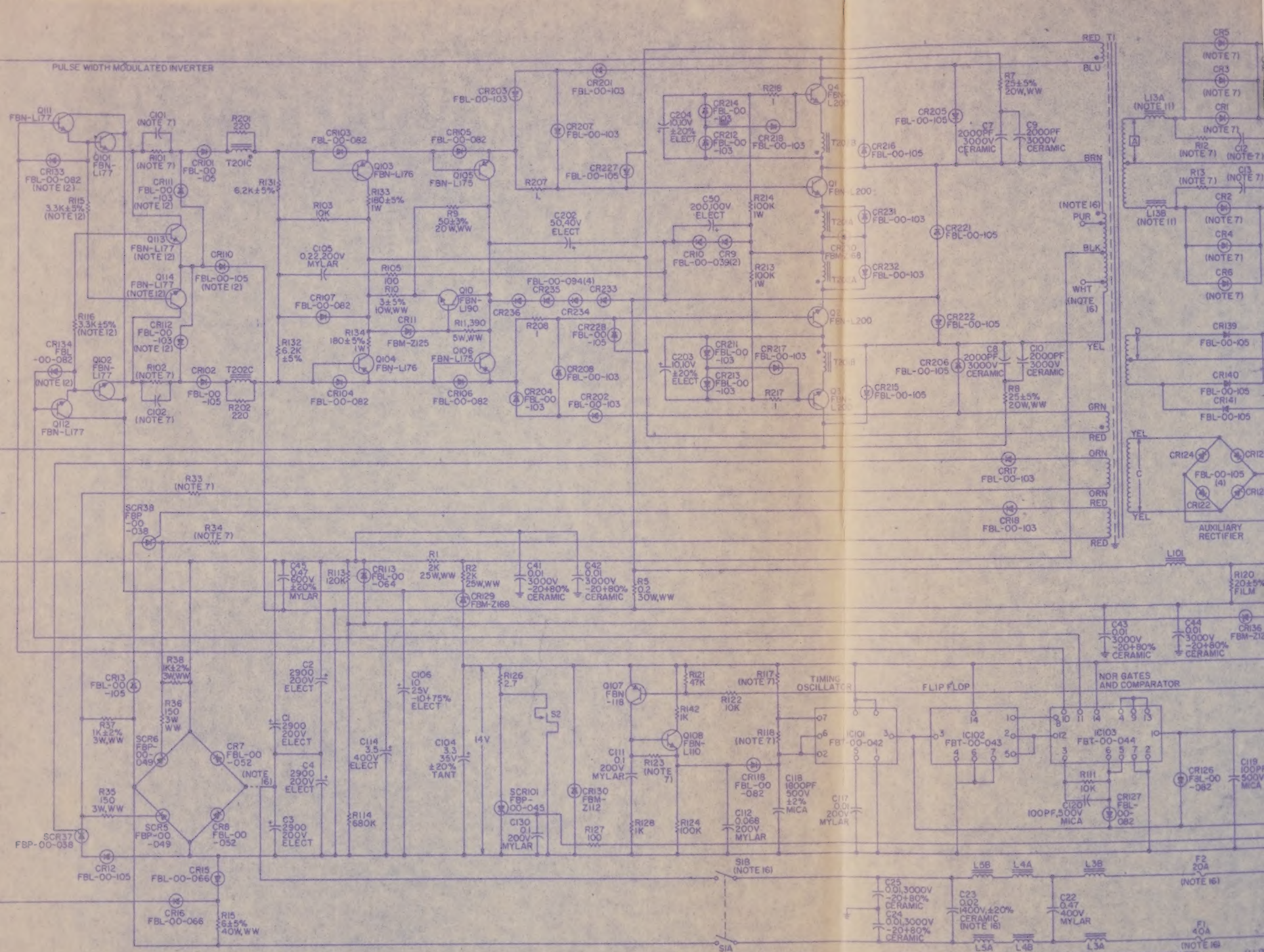
DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A.

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

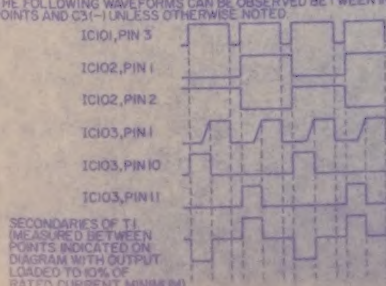
MODELS
LGS-G-6-28-0V

LAMBDA ELECTRONICS MELVILLE, NEW YORK
DIVISION OF VOLTRONICS CORP.



DESCRIPTION	DATE	APPL.
ORIG.	8/27/80	TJC

NOTES
1. RESISTORS ARE 1/2W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10%, FILM ±1%, WIREWOUND ±3%.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10+100%, CERAMIC ±10%, MYLAR ±10%, MICA ±5% UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT
   - * SEE INSTRUCTION MANUAL.
   - ⊗ LAMBDA PART NO. FBL-00-030, USE IN4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - ⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. SEE TABLE I FOR COMPONENT VALUES.
8. SEE TABLE I FOR VOLTAGE VALUES.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS INPUT: 115VAC, 57-63 Hz. OUTPUT: NOMINAL VOLTAGE NO LOAD +S AND +V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER. AC MEASUREMENTS ARE PEAK VALUES MEASURED WITH OSCILLOSCOPE. VOLTAGES ARE TAKEN BETWEEN INDICATED POINTS AND -S(TERM. 3) UNLESS OTHERWISE NOTED.
10. THE FOLLOWING WAVEFORMS CAN BE OBSERVED BETWEEN INDICATED POINTS AND C3(-) UNLESS OTHERWISE NOTED.



SECONDARIES OF T1 (MEASURED BETWEEN POINTS INDICATED ON DIAGRAM WITH OUTPUT LOADED TO 10% OF RATED CURRENT MINIMUM)

OVERSHOOT — No overshoot under conditions of power turn-on, turn-off, or power failure.

AC INPUT — 105-132, 205-265 or 187-242 ("V" option) VAC at 47-440 Hz.
Input power: 1800 Watts*. Input current: 24 amps**. For operation at frequencies above 440 Hz, consult factory.

*With output loaded to full current rating.
**With output loaded to full current rating and input voltage 105 VAC, 60 Hz,

INPUT FUSE — Fuse F1 protects the input wiring to the power supply. Overload of power supply does not cause fuse failure.

OVERLOAD PROTECTION

Thermal ..... Thermostat resets automatically when over-temperature condition is eliminated.

Electrical

External ..... Automatic electronic current limiting circuit, limits output current to a preset safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

Internal ..... Fuse F3 provides protection against internal circuit failure.

OVERVOLTAGE PROTECTION — All LGS-G models include fixed built-in overvoltage protection circuits which prevent damage to the load caused by excessive power supply output voltage. See table below for overvoltage protector firing ranges.

MODEL	OVERVOLTAGE PROTECTOR TRIP-POINT RANGE (VOLTS)
LGS-G-5-OV-R	6.4 — 6.8
LGS-G-6-OV-R	7.1 — 7.5
LGS-G-12-OV-R	13.3 — 14.1
LGS-G-15-OV-R	16.5 — 17.5
LGS-G-20-OV-R	22.1 — 23.5
LGS-G-24-OV-R	26.5 — 28.1
LGS-G-28-OV-R	30.9 — 32.9

INPUT CONNECTIONS — Terminal block on rear of chassis.

OUTPUT CONNECTIONS — ½-20 studs on rear of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE (non operating) — -55°C to 85°C

METERING — Digital panel meter monitors output voltage or load current as selected by METER SELECTOR switch.

FUNGUS — All LGS-G power supplies are fungus inert.

CONTROLS

Power	Panel mounted circuit breaker type switch.
Meter Selector	Selects meter function. Either output voltage or current can be monitored.
VDC Adj	Voltage adjust control permits adjustment of DC output over entire operating range.

PHYSICAL DATA

Size	5-3/16" X 19" X 14"
Weight	42 lbs. net, 45 lbs. shipping
Panel Finish	Charcoal brown (standard); Special finishes available to customer specifications at moderate surcharge.

MOUNTING — Standard 19" rack mounting

"V" OPTION — Standard LGS-G power supplies can be obtained for 205-265 VAC input or 187-242 VAC input. See nameplate for AC input rating. Derate output current rating 10% for 187-242 VAC input. For operation at frequencies above 440 Hz, consult factory.

ACCESSORIES

Chassis slides	Chassis slides KHT-24-014 are available.

OPERATING INSTRUCTIONS

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40° C. For continuous operation, load current must not exceed the rating for each ambient temperature. When rated load current is exceeded, voltage decreases towards zero and the current at short circuit is held to a safe value.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded AC lead to terminal 1.

The supply positive terminal is brought out to terminal 6. The supply negative terminal is brought out to terminal 4. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 9. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at a nominal 1000 ohms/volt change and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will nominally be minimum output voltage plus 1 volt per 1000 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of the programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 1 ma. minimum.

Alternatively, when supplies with less than 1 ma. reverse current capability are used, a resistor capable of drawing 1 ma. at the minimum programming voltage must be connected across the output terminals of the programming supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LGS-G power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of SPECIFICATIONS AND FEATURES, for power supply current and voltage ratings.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown. The thermostat shuts down inverter operation only when the temperature of the main rectifier heat radiator exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value.

Fuse Shutdown. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Overvoltage Shutdown. When the power supply output voltage increases above the overvoltage limit, HC1 will short circuit output of the supply and SCR101 will shut down inverter operation. After eliminating the cause(s) for overvoltage, resume operation of the supply by interrupting the AC input circuit for a period of 30 seconds. (Refer to TROUBLE SHOOTING CHART).

MAINTENANCE

GENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on SPECIFICATIONS AND FEATURES for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before troubleshooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 8, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal no load operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an in-circuit transistor checker. If no checker is available, transistors can be checked with an ohmmeter that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never ZERO; backward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional faulty components could damage the replaced component.

When soldering semi-conductor devices, hold the lead being soldered with a pair of pliers or a commercial heat sink device placed between the component and the solder joint.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact, but not covered with solder, it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.

3. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

   a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

   b) Dip the wick in liquid rosin flux.

c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

a) AC power of proper voltage and frequency is present at input terminals.

b) Either positive or negative terminal is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

TROUBLE SHOOTING CHART

Symptom	Possible Cause	Remedy
1. Zero volts DC output, voltages across C1, C2 and C3, C4 read zero.	Open F1, CR7, CR8, SCR5, SCR6.	Check and replace as necessary.
2. Same as 1, voltages across C1, C2 and C3, C4 are correct, voltage across C104 is zero.	Thermostat S1 closed.	Refer to table 1 of SPECIFICATIONS AND FEATURES for current ratings at given ambient temperature. After allowing time for the power supply to cool, resume operation of the supply.
	SCR101 fired due to OV condition.	Interrupt AC input for 30 seconds. If supply operates normally, a transient has occurred, check wiring (switches, etc.). If supply fails to reach full output voltage, remove AC input, disconnect +V terminal of HC1, remove load, apply AC power and refer to procedure for: Output Too High "Symptom 4."
	R1 or R2 open, CR130 shorted.	Check and replace as necessary.
3. Same as 1, voltages across C1, C2, C3, C4, C104 are correct.	Q1, Q2, Q3, Q4, R5 open.	Check and replace as necessary.

TROUBLE SHOOTING CHART

Symptom	Possible Cause	Remedy
4. Output voltage too high.	Open sense lead.	Check load and load connections, correct as necessary.
	Defective HC101. Open R119, R19, R130, CR122 — CR125	Check and replace as necessary.
5. Very low output voltage, voltage across C104 reads correct	R126, R127 open. HC101, SCR101 defective	Check and replace as necessary.
6. High ripple	Defective HC101	Replace as required.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 9. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the no load to load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R125.

Whenever HC101, R5, or R125 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R125 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30° C, and is stabilized and not operating.

1. Remove AC input power to the supply.
2. Break seal on wiper of R125 from resistor housing and turn to full CW position.
3. Operate power supply for constant voltage with local sensing connected as shown in figure 3, with no external load, and with AC input of 105 VAC, 60 Hz.
4. Turn voltage adjust control until minimum rated output voltage is obtained.
5. Apply load so that output current is 105% of 40° C rating for the unit.
6. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R125 in CCW direction. Adjust R125 until output ripple increases sharply and the unit emits an audible noise. Readjust R125 in CW direction until output ripple is restored to its original value and the noise ceases.
7. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R125 to resistor housing.
8. After sealing, check setting and repeat adjustment procedure if required.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not electronic part, or is not listed, provide a description, function, and location, of the part.

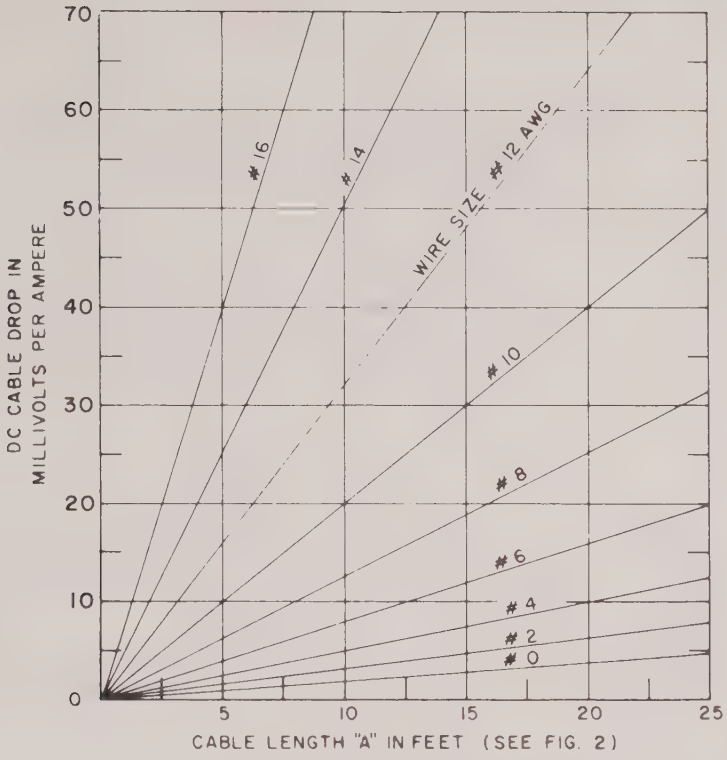


Figure 1. Cable Ccnnection Chart.

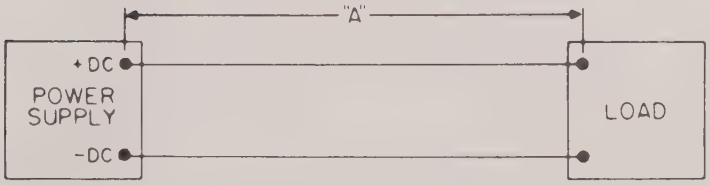


Figure 2. Cable Length "A" in Feet.

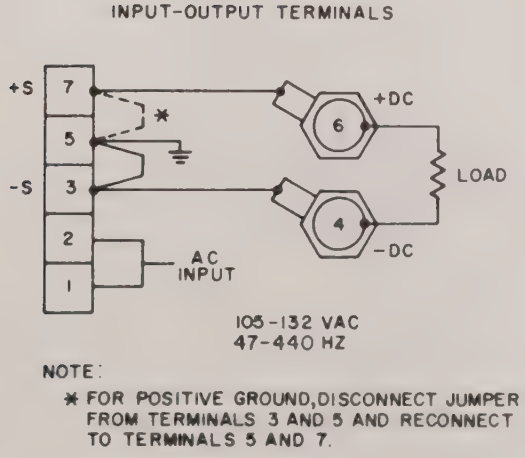


Figure 3. Local Sensing Connection.

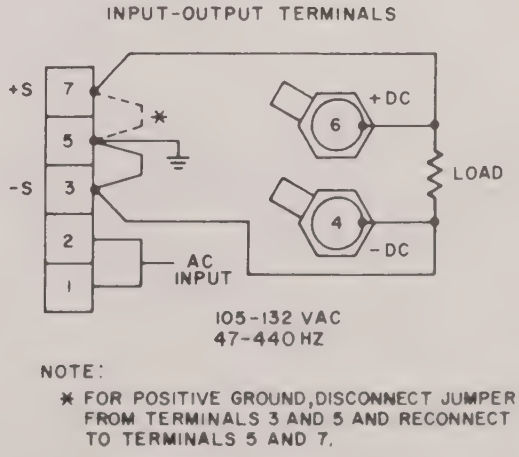


Figure 4. Remote Sensing Connection.

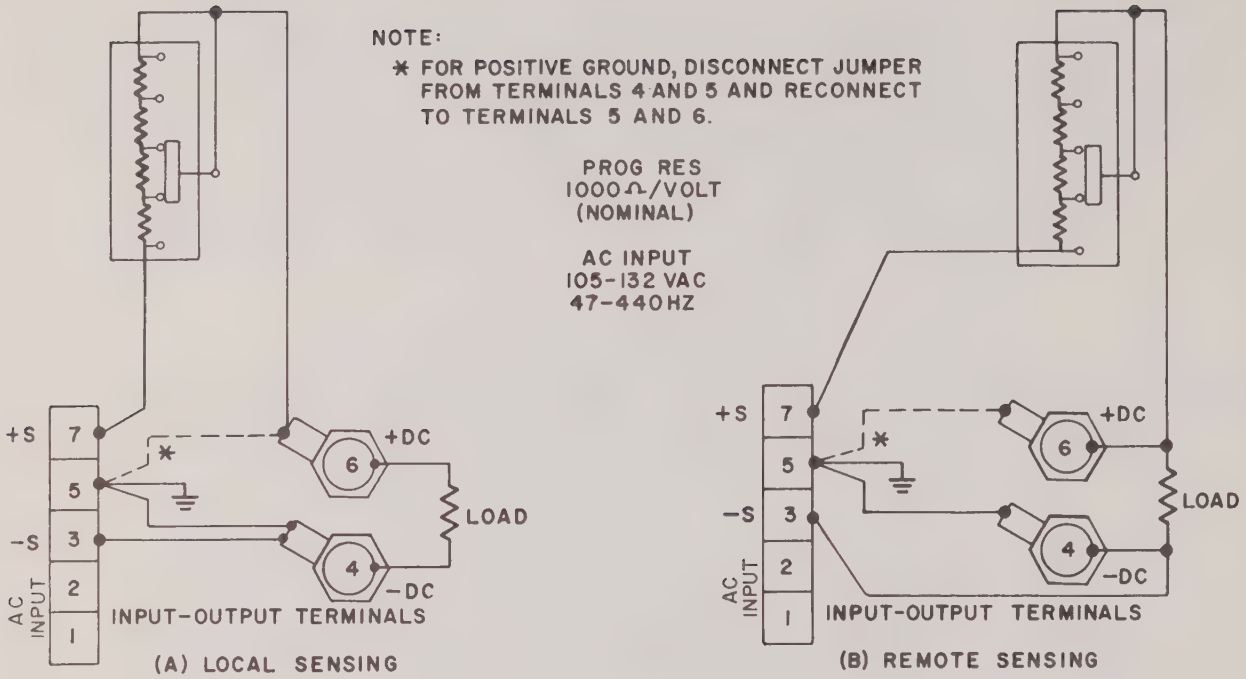


Figure 5. Programmed Voltage, With External Resistor.

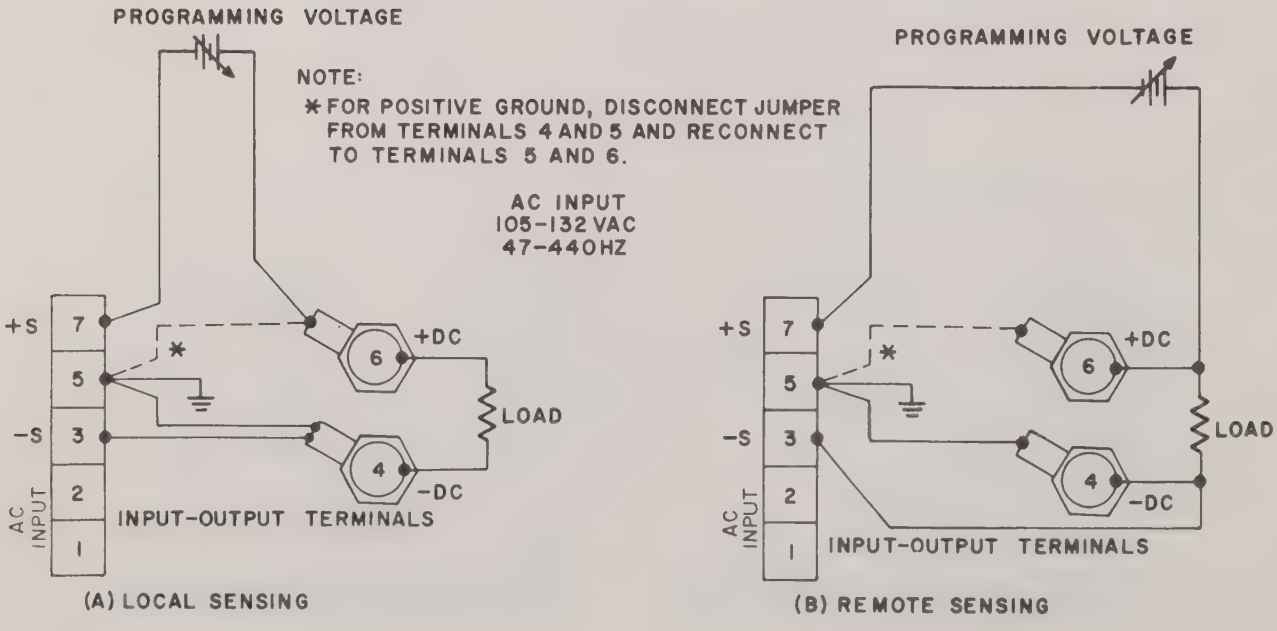
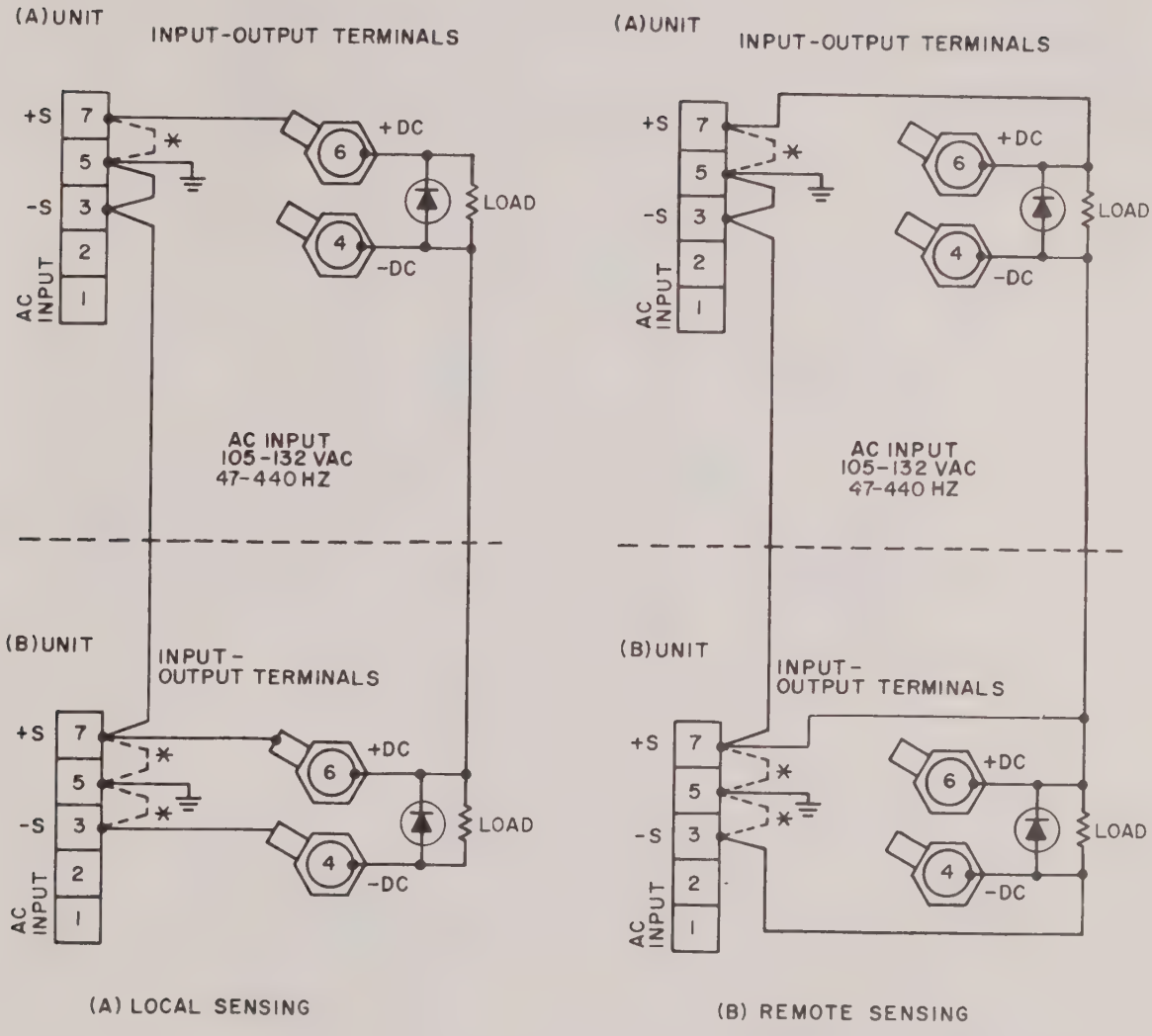


Figure 6. Programmed Voltage, With External Programming Voltage Source.



NOTE:

* MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 3 ON (A) UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

Figure 7. Series Connection.

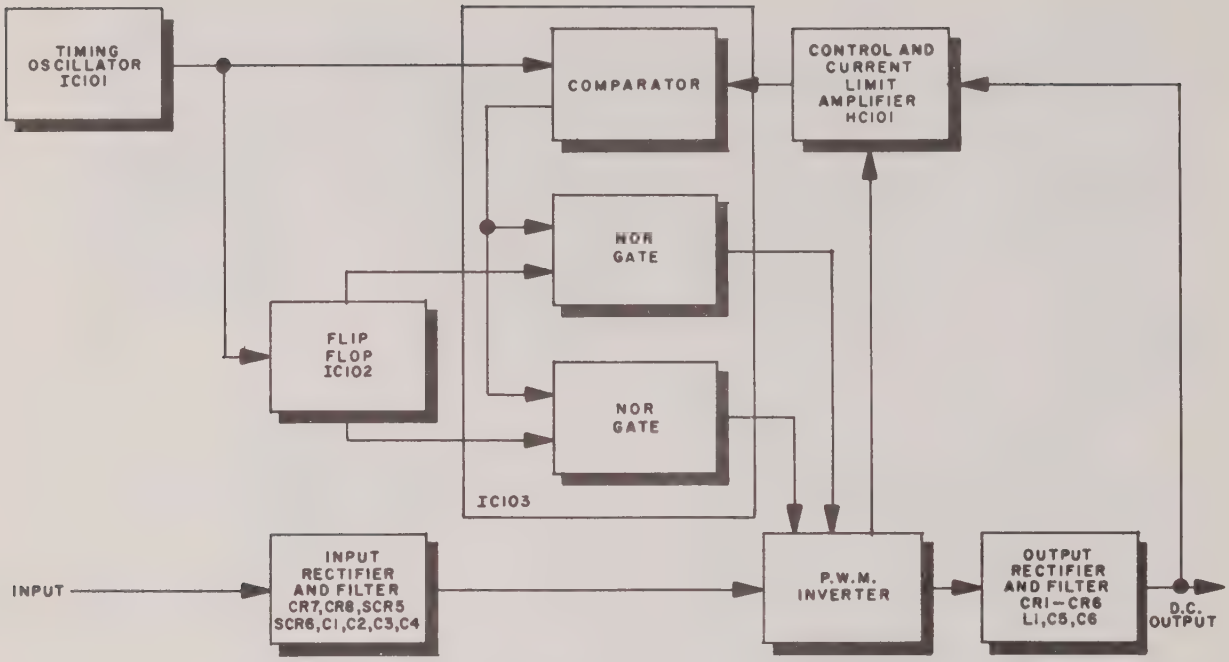
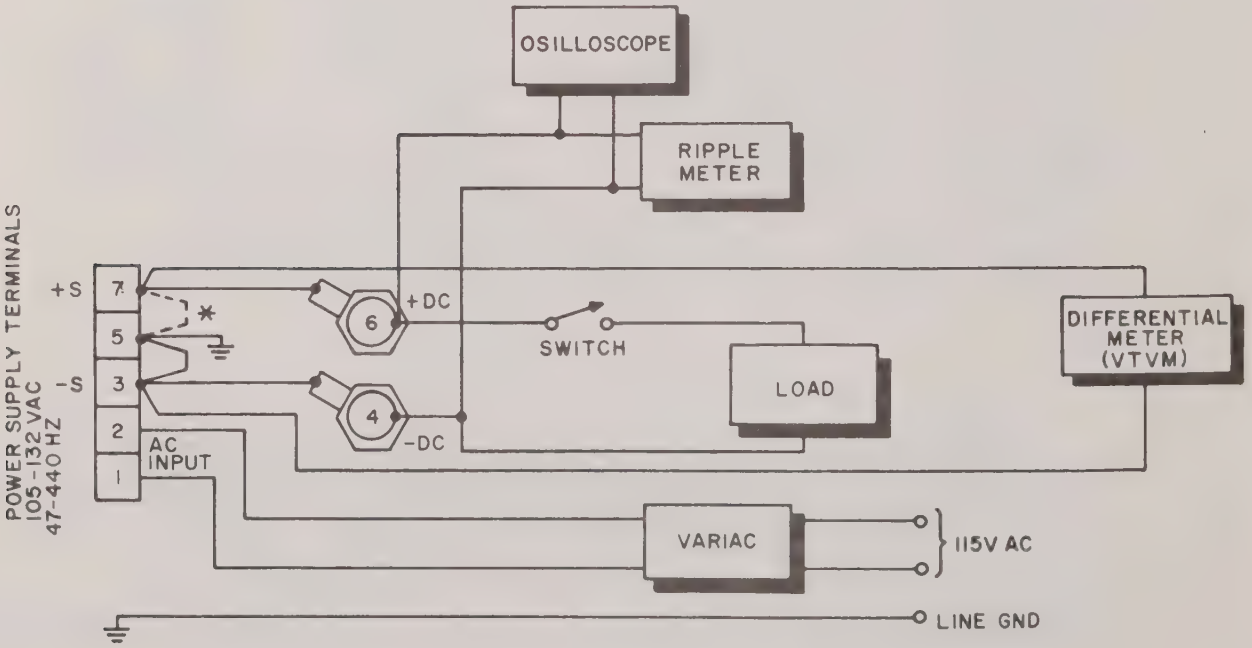


Figure 8. Typical Block Diagram.



NOTES:
1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.

Figure 9. Test Connections for Performance Checks.

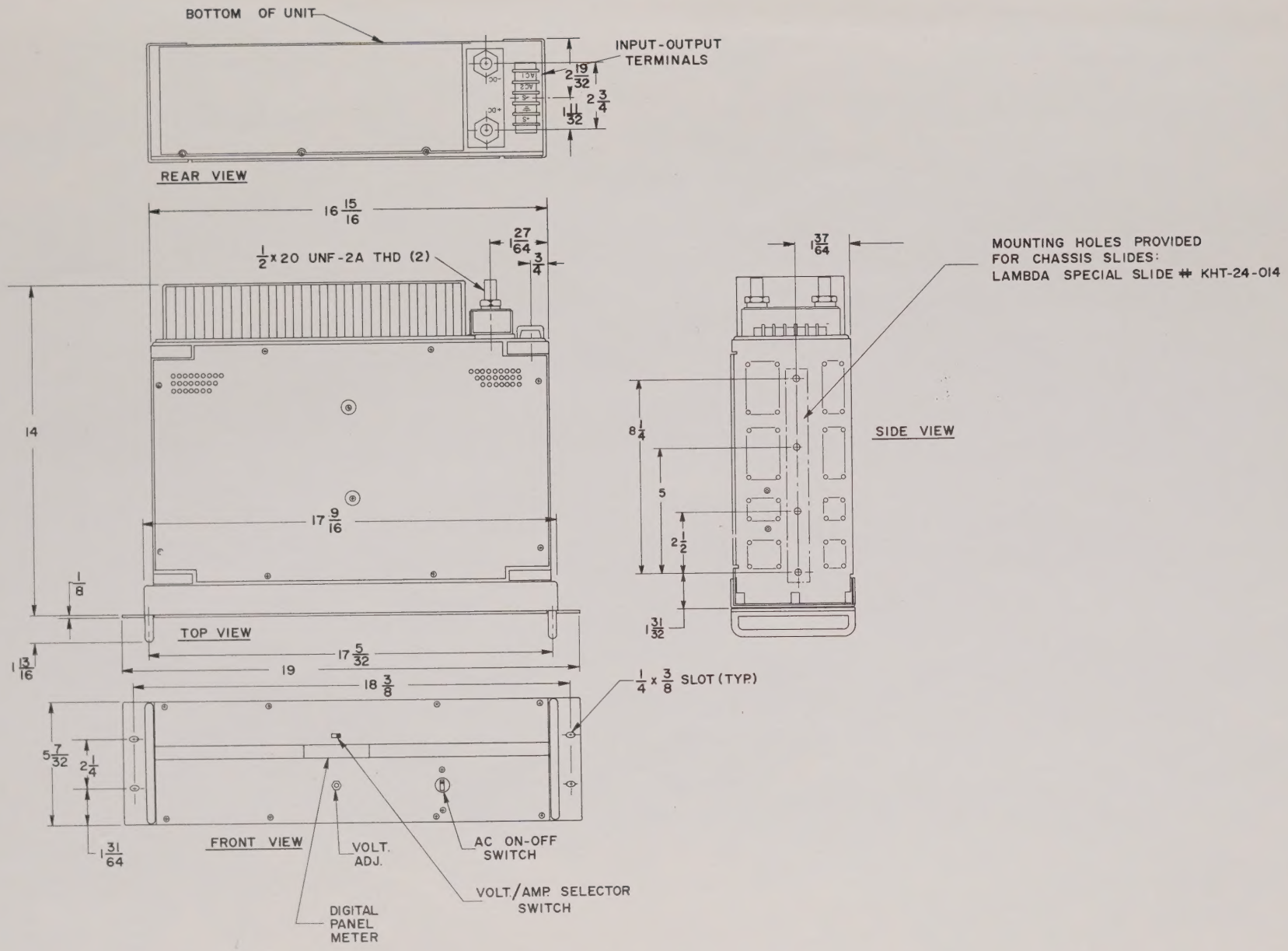
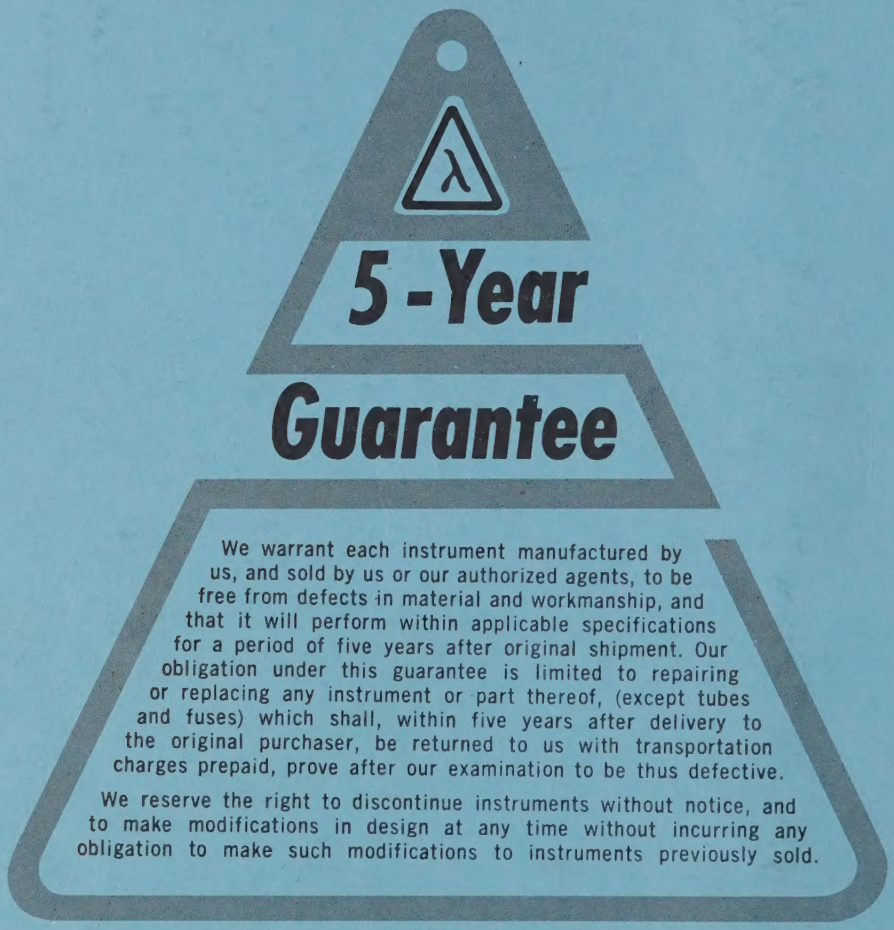


Figure 10. Outline Drawing.


5 - Year
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We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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